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10/593,356	09/18/2006	Michael Shannon Mccorquodale	1090.009-US	1300

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EXAMINER	
GOODLEY, JAMES E	

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2817	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/593,356	MCCORQUODALE ET AL.	
	Examiner	Art Unit	
	JAMES E. GOODLEY	2817	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *18 February 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2,4-14 and 16-39* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,4-14,16-26 and 28-39* is/are rejected.

7)☒ Claim(s) *27* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *9/18/2006* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *2/18/2009*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

Applicant's arguments filed 2/18/2009 have been fully considered but they are not persuasive.

Applicant argues first and foremost that Duncan is directed towards a VCO which needs to be tuned by a phase locked loop and thus cannot be combined with McCorquodale, which is an LC-based reference oscillator. However, McCorquodale recognizes in the background of the invention that the problems with prior art frequency generators (such as PLLs) is that they usually require a crystal oscillator as a reference frequency generator, which cannot be fully integrated. Prior Art attempts at producing fully-integrated reference generators have had numerous problems, including temperature and frequency instability. The McCorquodale invention is directed principally at fabricating a stable, fully-integrated frequency generator with a MEMS-based LC oscillator design. McCorquodale overcomes the frequency instability problem through the use of highly accurate MEMS inductors and capacitors which have a high Q-factor and can be fully integrated. Although McCorquodale recognizes the temperature problem (see lines 63-66 of column 1), there is no temperature compensation of the reference oscillator in McCorquodale.

However, Duncan discloses an LC oscillator with the same general circuit topology as McCorquodale, albeit without MEMS architecture. Both circuits are LC oscillators based off of cross-coupled negative resistance cells. Duncan adds

temperature compensation through the use of a current mirror [4536] and adaptive bias circuitry [4522] to stabilize the oscillation frequency over temperature.

The only combination that is made in the rejection is to combine Duncan's teaching of temperature compensation to an LC based oscillator into the LC oscillator of McCorquodale. Clearly, the references are analogous enough to support a proper obviousness rejection. The alternative rejection based on McCorquodale in view of Duncan is made in this action as well.

Applicant notes that any changes in trans-conductance of M1 and M2 in the VCO of Duncan therefore, have no effect on the VCO operating frequency. However, that is precisely the purpose of the current mirror and adaptive bias in Duncan. The current I in the current mirror varies with temperature causing the adaptive bias current to M1 and M2 to vary with temperature, such that the trans-conductance of M1 and M2 is held constant (see paragraphs 540-549). Since the oscillation frequency of the VCO varies with trans-conductance, fixing the trans-conductance to be temperature insensitive holds the oscillation frequency "substantially constant" as required in the claims. Applicant's argument that the biasing scheme of Duncan does not modify a current in response to a temperature variation (and therefore does not modify the oscillation frequency to be temperature insensitive) is incorrect based on the operation of the circuit in Duncan.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 2, 4, 5, 7-26, 29, 30, 33, 36 and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over ***McCorquodale et al. (US 6,972,635 – of record)*** in view of ***Duncan et al. (US 2003/0030497 – of record).***

Regarding **claims 1, 2, 4, 5, 7-14, 16-26, 29, 30, 33, 36 and 39**, Fig. 7a of McCorquodale discloses an apparatus for frequency control, the apparatus comprising:

a reference resonator comprising an inductor and a capacitor [LC tank 64, 40 and 80], the reference resonator to provide a first signal [differential output of cross coupled transistors] having a resonant frequency; and

a negative trans-conductance amplifier [cross coupled PMOS and NMOS transistors] coupled to the reference resonator.

McCorquodale discloses in Figs. 4-7 a biased integrated MEMS LC oscillator. McCorquodale discloses in lines 32-60 of column 1 and lines 41-44 of column 4 the desire for a low-cost integrated oscillator that does not require an external crystal clock generator. The LC tank of Fig. 6 and oscillator of Fig. 7 disclosed in column 19 and 20 are the inventive solution to the problem. Thus, the LC oscillator of McCorquodale is a fully integrated clock generator that does not require an external clock generator for tuning. McCorquodale includes a variable capacitor [40, 80] responsive to a control voltage [Vcntrl] to modify the reactance of the reference resonator.

McCorquodale fails to specifically disclose a frequency controller for maintaining the reference resonator substantially constant in response to a variation of a parameter (such as temperature).

However, Fig. 45I of Duncan discloses an apparatus for frequency control, the apparatus comprising:

a resonator [LC tank comprising inductors 4509 and varactors 4515], the reference resonator adapted to provide a first signal having a resonant frequency;

a negative transconductance amplifier [NMOS drivers M1 and M2] coupled to the resonator; and

a frequency controller [current mirror 4536 and current source adaptive bias 4522] coupled to the amplifier and coupled to the resonator, the frequency controller adapted to modify the resonant frequency of the reference resonator in response to at least one variable of a plurality of variables (frequency, temperature and fabrication process variations – see paragraph 549).

The cascode current mirror/voltage isolator and adaptive bias modify a current through the amplifier (and therefore the transconductance and oscillation frequency) according to temperature variation and according to the supply voltage.

The temperature dependent current mirror source 4536 comprises first and second transistors [M4, M5], a diode [diode connected M6] and a resistor [R2].

Line 42 of column 6 to line 7 of column 12 and lines 62-65 of column 20 disclose the usage of first and second MOS transistors being biased in strong inversion and weak inversion (subthreshold region).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the LC oscillator device of McCorquodale by including temperature compensation, for the purpose of making a low-cost and fully integrated clock generator that is substantially insensitive to process and temperature variation.

It is a necessary consequence of the combination that the temperature compensator biasing circuit be coupled to the LC tank of McCorquodale through the negative trans-conductance amplifier [cross-coupled PMOS circuit] of McCorquodale.

Claims 1, 2, 4, 5, 7-26, 29, 30, 33, 36 and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over ***Duncan et al. (US 2003/0030497 – of record)*** in view of ***McCorquodale et al. (US 6,972,635 – of record)***.

Regarding **claims 1, 2, 4, 5, 7-14, 16-26, 29, 30, 33, 36 and 39**, Fig. 45I of Duncan discloses an apparatus for frequency control, the apparatus comprising:

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a negative transconductance amplifier [NMOS drivers M1 and M2] coupled to the resonator; and

a frequency controller [current mirror 4536 and current source adaptive bias 4522] coupled to the amplifier and coupled to the resonator, the frequency controller adapted to modify the resonant frequency of the reference resonator in response to at least one variable of a plurality of variables (frequency, temperature and fabrication process variations – see paragraph 549).

The cascode current mirror/voltage isolator and adaptive bias modify a current through the amplifier (and therefore the transconductance and oscillation frequency) according to temperature variation and according to the supply voltage.

The temperature dependent current mirror source 4536 comprises first and second transistors [M4, M5], a diode [diode connected M6] and a resistor [R2].

Line 42 of column 6 to line 7 of column 12 and lines 62-65 of column 20 disclose the usage of first and second MOS transistors being biased in strong inversion and weak inversion (subthreshold region).

Duncan fails to specifically disclose that the resonator is a reference resonator to create a reference clock (as the oscillator is a VCO, tuned from another external crystal oscillator in a PLL circuit).

However, McCorquodale discloses in Figs. 4-7 a biased integrated MEMS LC oscillator. McCorquodale discloses in lines 32-60 of column 1 and lines 41-44 of column 4 the desire for a low-cost integrated oscillator that does not require an external crystal clock generator. The LC tank of Fig. 6 and oscillator of Fig. 7 disclosed in column 19 and 20 are the inventive solution to the problem. Thus, the LC oscillator of McCorquodale is a fully integrated clock generator that does not require an external clock generator for tuning. McCorquodale includes a variable capacitor [40, 80] responsive to a control voltage [Vcntrl] to modify the reactance of the reference resonator.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the LC oscillator device of Duncan by using it as a

reference clock generator, without being tuned from an external clock source in a phase locked loop (PLL), as suggested by McCorquodale, for the purpose of making a low-cost and fully integrated clock generator that is substantially insensitive to process and temperature variation.

It is a necessary consequence of the combination that the temperature compensator biasing circuit be coupled to the LC tank of McCorquodale through the negative trans-conductance amplifier [cross-coupled PMOS circuit] of McCorquodale.

Claims 6, 28, 31 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over ***McCorquodale et al. (US 6,972,635 – of record)*** in view of ***Duncan et al. (US 2003/0030497 - of record)*** in further view of ***Hayashi et al. (US 5,180,995 – of record)***.

Regarding **claims 6, 28, 31 and 32**, the device of McCorquodale in view of Duncan fails to specifically disclose, wherein the current source has one or more configurations selected from a plurality of configurations, the plurality of configurations comprising CTAT, PTAT, and $PTAT^2$ configurations.

However, Hayashi discloses in Fig. 1 and the abstract a temperature compensation current mirror utilizing a CTAT [thermistor R2, having a negative temperature coefficient] and a PTAT [thermistor R1, having a positive temperature.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the device of McCorquodale in view of Duncan, by including a PTAT and CTAT in the current mirror, as such thermistors are conventional

in the art and using both a PTAT and CTAT in the current mirror would provide a more accurate temperature compensation to provide a more accurate oscillation frequency.

Claims 6, 28, 31 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over ***Duncan et al. (US 2003/0030497 - of record)*** in view of ***McCorquodale et al. (US 6,972,635 – of record)*** in further view of ***Hayashi et al. (US 5,180,995 – of record)***.

Regarding **claims 6, 28, 31 and 32**, the device of Duncan in view of McCorquodale fails to specifically disclose, wherein the current source has one or more configurations selected from a plurality of configurations, the plurality of configurations comprising CTAT, PTAT, and $PTAT^2$ configurations.

However, Hayashi discloses in Fig. 1 and the abstract a temperature compensation current mirror utilizing a CTAT [thermistor R2, having a negative temperature coefficient] and a PTAT [thermistor R1, having a positive temperature.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the device of Duncan in view of McCorquodale, by including a PTAT and CTAT in the current mirror, as such thermistors are conventional in the art and using both a PTAT and CTAT in the current mirror would provide a more accurate temperature compensation to provide a more accurate oscillation frequency.

Claims 34, 35, 37 and 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over ***McCorquodale et al. (US 6,972,635 – of record)*** in view of ***Duncan***

et al. (US 2003/0030497 - of record) in further view of ***Schmidt (US 7,098,748 – of record)***.

Regarding **claims 34, 35, 37 and 38**, the device of McCorquodale in view of Duncan fails to specifically disclose, wherein the frequency controller further is to generate the control voltage in response to the temperature variation.

However, Schmidt discloses in Fig. 2 stabilizing a reference oscillator [50] over temperature, process and shock variations by varying the capacitance of a varactor in the oscillator according to levels measured by temperature, process and shock sensors [10-14] as decoded by the CPU. The RAM and ROM contain coefficient registers to store a plurality of coefficients calibrated over the temperature, process and shock variation regions to generate the corresponding control voltage to the varactor 66.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the device of McCorquodale in view of Duncan, by including alternatively, a variable capacitance based temperature compensation, as such would be an equivalency to the biasing scheme adopted in Duncan.

Claims 34, 35, 37 and 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over ***Duncan et al. (US 2003/0030497 - of record)*** in view of ***McCorquodale et al. (US 6,972,635 – of record)*** in further view of ***Schmidt (US 7,098,748)***.

Regarding **claims 34, 35, 37 and 38**, the device of Duncan in view of McCorquodale fails to specifically disclose, wherein the frequency controller further is to generate the control voltage in response to the temperature variation.

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It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the device of Duncan in view of McCorquodale, by including alternatively, a variable capacitance based temperature compensation, as such would be an equivalency to the biasing scheme adopted in Duncan.

Allowable Subject Matter

Claim 27 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding **claim 27**, the device of Duncan in view of McCorquodale fails to disclose or suggest, wherein a first set of transistors of the plurality of transistors are

operable in strong inversion and a second set of transistors of the plurality of transistors are operable at a subthreshold voltage.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JAMES E. GOODLEY whose telephone number is (571)272-8598. The examiner can normally be reached on Monday-Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Robert J. Pascal can be reached on (571)272-1769. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/James E Goodley/
Examiner, Art Unit 2817

/Robert Pascal/
Supervisory Patent Examiner, Art Unit 2817